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JELUTONG.

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Introduction.

The production of jelutong, the resinous material obtained by the coagulation of the latex derived from certain species of trees belonging to the genus *Dyera* (Natural Order Apocynaceae), is becoming of considerable importance in this country on account of the increased requirements of the United States of America for this substance in the manufacture of chewing gum.

Jelutong trees, which are among the finest of jungle trees, are found scattered throughout Malaya, and jelutong production in this country is therefore under the control of the Forest Department, which grants permits for tapping trees in certain areas. The method of tapping is governed by certain rules, having for their object the preservation of the tree from injury during the period of tapping, so that the ultimate value of the timber may not suffer through the tree being attacked by disease or insects as a result of careless or too severe tapping.

At present large quantities of jelutong are produced in Borneo, Sarawak and the Netherlands East Indies, the material being shipped to Singapore for grading and re-export. In fact the bulk of the jelutong exported from Singapore is imported originally from those countries, local production forming only a small percentage of the total exports.

The United States of America are the largest consumers of jelutong, the annual export to that country exceeding 95 per cent of the total amount exported from Singapore. It is understood that practically all the jelutong thus imported is used in the manufacture of chewing gum and other sweetmeats.

In this connection the following tables giving the details of local production and of imports and exports of jelutong for the past two and a half years may be of interest.

EXPORTS FROM FEDERATED MALAY STATES.

Year	Quantity. (Tons)	Value. ($)	Value per ton. ($)
1924 ...	232.3	77,266	333
1925 ...	503.7	232,678	462
1926 (3 months) ...	141.4	88,772	628

IMPORTS AND EXPORTS FROM BRITISH MALAYA.

IMPORTS.

Year	Quantity (Tons)	Value ($)	Value per ton. ($)
1924 ...	6,569	1,480,552	225
1925 ...	5,518	1,647,508	299
1926 (6 months) ...	3,928	2,300,539	586

EXPORTS.

1924 ...	5,843	1,953,676	334
1925 ...	6,622	2,934,552	443
1926 (6 months) ...	4,173	3,201,258	767

EXPORTS TO UNITED STATES OF AMERICA.

Year	Total Export. (Tons)	Export to U.S.A. (Tons)	U.S.A. Per cent. of Total.
1924 ...	5,843	5,622	96.3
1925 ...	6,622	6,324	95 5
1926 (6 months) ...	4,173	4,066	97.9

It may be mentioned here that jelutong as exported contains approximately 50 per cent of moisture, so that the figures for the quantities in the above tables should be halved in order to arrive at the corresponding amount of dry jelutong. The value per ton of the dry material will also be approximately double the figure shown in every case.

The increasing importance of jelutong has therefore led to an investigation on the most satisfactory methods of coagulation of the latex in order to obtain the maximum yield, and also of preserving and marketing the product in order that deterioration during storage and transit may be reduced to a minimum.

The present article deals only with coagulation of the latex and the experimental work has been carried out principally with latex supplied from the Weld Hill Forest Reserve, in which the Forest Department are carrying out a series of tapping experiments.

It is hoped to deal with the question of preservation and marketing in a future article.

General Considerations on Coagulation of Jelutong Latex.

Reference to previous papers in this Journal on this subject, compare " Jelutong " by B. J. Eaton and J. H. Dennett, Vol. XI., 1923, Nos. 7-9, page 219 and " Further Studies on Jelutong " by V. R. Greenstreet, Vol. XIII, 1925, No. 1, page 1, will show that the coagulation of the latex can be carried out in various ways, but no details are available as to the state of coagulation in the different experiments. In the present investigation it was decided therefore to adopt a standard for complete coagulation, which, as in the case of Hevea latex, is the separation and coalescence of the jelutong globules to a coherent clot leaving a clear serum.

Among the coagulants used in the preliminary experiments were acetic acid, alum, sulphuric acid and sodium silicofluoride, all of which react satisfactorily with Hevea latex and are at present used for the coagulation of jelutong latex.

The experiments showed that the rate of coagulation was slow compared with that of Hevea latex, and further that it was difficult to effect complete coagulation, as defined above, with any of these coagulants. The only method by which complete coagulation could be effected with certainty was by dropping the latex into alcohol, while stirring the liquid continuously. The amount of alcohol required was about one and a half times the volume of the latex. A compact clot was formed and, although occasionally the serum was not clear, flocculation always occurred after a few hours, resulting in the separation of a white precipitate and a clear serum.

When carrying out comparative tests with different coagulants therefore, a control coagulation was always carried out with alcohol, and the amount of dry jelutong (clot plus a flocculent precipitate) obtained was taken as a measure of the total jelutong content of the latex.

Aerobic and anaerobic coagulation were also tried. Aerobic coagulation was by no means successful, but good results were obtained by the anaerobic method, although the period required to effect coagulation was long, generally between four and five days. The coagulum had a somewhat sour smell, which it was thought might be difficult to remove subsequently, and it was decided to discontinue the experiments in this direction.

The coagulants selected for the final experiments were sodium silicofluoride and acetic acid. Sodium silicofluoride was selected, since it was thought that this substance might

also act as a preservative, while acetic acid was chosen because it is the most suitable coagulant for Hevea latex.

Sulphuric acid was not selected on account of the prejudice which exists regarding the employment of this substance in the manufacture of food products, while alum was not recommended on account of the efforts which have been made in this country to prevent its use as a coagulant for Hevea latex.

As will be seen later, satisfactory results were obtained with sodium silicofluoride and it was decided to recommend this substance as a coagulant, when information was received from various firms in the United States of America interested in jelutong that, on account of the toxic nature of sodium silicofluoride, its use in the preparation of food products would be contrary to the food laws of that country and the recommendation had therefore to be cancelled.

In view however of the satisfactory results obtained and of the possibility that jelutong may be used in products other than foodstuffs, it was considered desirable to publish the results of the experiments with this coagulant.

Properties of Jelutong Latex.

Jelutong latex contains spherical globules which are much smaller than those of Hevea latex; the globules are in Brownian motion suspended in an aqueous medium, containing in solution various organic and inorganic substances.

The fresh latex has a specific gravity of 1.012—1.015 at 28°C, which indicates a considerable proportion of soluble solids in the serum compared with Hevea latex.

It would appear that, as with Hevea latex, the total solids in the latex vary according to the age of the tree and the method of tapping. Thus, in the Weld Hill Forest Reserve, with many of the trees not full grown and tapping on a light basis, an average sample of latex yields total solids amounting to about 22 per cent, while in the Sungei Buloh Forest Reserve, where the trees are full grown and about to be felled, and the tapping is heavy, the total solids on the average amount to only about 18 per cent.

It is interesting to note that the amount of total solids obtained by evaporation is considerably in excess of the amount of jelutong obtained by the coagulation with alcohol; thus, taking the amount of jelutong coagulated by alcohol as 100 the amount of total solids is about 120—125.

No investigation has yet been made of the substances present in the latex not coagulated by alcohol, except that

they are chiefly organic, the proportion of ash in the jelutong latex being low.

Experiments on Coagulation.

(a) *General.*—In coagulation experiments with jelutong latex it was found advisable, after mixing the coagulant, to leave the latex undisturbed during the period of coagulation.

It was found that better results were obtained if coagulation took place from the surface downwards rather than from the bottom upwards, and this was only possible if the latex were left undisturbed and a skin allowed to form on the surface. It would appear therefore that the process of coagulation is dependent to a certain extent upon anaerobic conditions, even though a coagulant is present.

This was shown in the following experiment:—Two quantities of latex (2000 ccs) were treated with the same amount of acetic acid (10 ccs of a 10 per cent solution), one being coagulated in a tall cylinder and the other in a large open basin. Both quantities of latex were allowed to stand for three days.

In the case of the tall cylinder, coagulation took place from the surface downwards, and at the end of the period it was noticed that coagulation was practically complete. The coagulum was firm and occupied approximately the same volume as that of the original latex, the amount of dry jelutong obtained being 298 grammes.

The latex treated in the basin was only partially coagulated, the surface of liquid exposed being so great in proportion to the depth that coagulation could not take place from the surface downwards. The skin formed was apparently unable to withstand the increasing quantity of coagulum, evident from the number of cracks in the skin and the manner in which it had been dragged away from the inside surface of the basin. The serum was still thick and milky, and the amount of dry jelutong obtained was only 246 grammes.

For the estimation of the dry jelutong the coagulum is washed with water to remove most of the non-coagulable solids and then pressed into small lumps. The lumps are then creped in a small crepeing machine, and the thin crepe hung to dry for two or three days in a current of hot air. The partially dried crepe is then weighed, and an aliquot portion taken for the absolute moisture determination, which is carried out by drying to constant weight in a steam oven.

(b) *Coagulation with Sodium Silicofluoride.*—The only difficulty in using sodium silicofluoride as a coagulant is the

low solubility of this substance in water, which at ordinary temperature is about 1 part in 200, increasing to about 1 part in 40 at 100°C.

In order to ensure satisfactory distribution of the coagulant throughout the latex it is advisable to add the required quantity in the form of a hot solution. This was shown by experiments in some of which this substance was added in the form of a fine powder, in others as a hot solution. In all cases it was found that better results were obtained with the solution.

It was found also that the best coagulation was obtained by the addition of 0.035 gramme per 100 ccs of latex, equivalent to 0.056 ounces per gallon of latex, i.e. approximately one-twentieth of an ounce per gallon of latex. Using a 1 per cent solution, the above quantities are equivalent to 3.5 ccs of solution per 100 ccs of latex or 5.6 fluid ounces per gallon of latex.

In general it may be said that coagulation with sodium silicofluoride is complete in about three days, and the percentage coagulation obtained with this method is on the average between 90 and 95 per cent of that obtained with alcohol.

Experiments showed that dilution of the latex inhibited the rate of coagulation to a considerable extent; thus, in the case of latex diluted with half the volume of water the percentage coagulation obtained in three days is reduced to approximately 70 per cent of the standard, while dilution with an equal volume of water reduces the percentage to about 50 per cent.

The figures in Table I obtained in a series of experiments with this coagulant show clearly the extent of coagulation on different days, as well as the retardation of coagulation produced by diluting the latex.

Other experiments were also carried out to ascertain whether it would be possible to reduce the period of coagulation by increasing the proportion of sodium silicofluoride. It was found that an increase in the proportion of this coagulant resulted in a diminution of coagulation, until with a concentration of 1 per cent, calculated on the latex, the latter still remained liquid after a period of 3 days, except for a thin skin on the surface. It is interesting to note therefore that, in low concentrations, sodium silicofluoride acts as a coagulant, while with a slightly increased concentration it becomes a preservative.

TABLE I.

RESULTS OF COAGULATION EXPERIMENTS WITH SODIUM SILICOFLUORIDE.

(2.5 c.c. of 1 per cent. solution per 100 c.c. of latex).

(*Results expressed in grammes per 100 c.c. of latex*).

Total Solids.	Alcohol Coagulation.	Details of Dilution.									Remarks.
		Latex Undiluted.			2 Latex : 1 Water.			1 Latex : 1 Water.			
		1 Day	2 Days	3 Days	1 Day	2 Days	3 Days	1 Day	2 Days	3 Days	
22.70 (124.6)	18.21 (100.0)	8.24 (45.2)	15.29 (84.0)	16.63 (91.3)	5.30 (29.1)	11.21 (61.6)	13.65 (75.0)	0.98 (5.4)	7.12 (39.1)	10.25 (56.3)	The figures in brackets represent the percentages of jelutong obtained in the various experiments, the amount obtained by coagulation with alcohol being taken as 100 per cent.
22.90 (124.8)	18.35 (100.0)	6.37 (34.7)	14.27 (77.8)	15.81 (86.2)	3.87 (21.1)	9.92 (54.1)	12.52 (68.2)	0.83 (4.5)	4.19 (22.8)	7.95 (43.3)	
22.32 (120.3)	18,56 (100.0)	13.05 (70.3)	16.55 (89.2)	17.46 (94.1)	8.62 (46.4)	13.31 (71.7)	15.83 (85.3)	3.95 (21.3)	8.86 (47.7)	11.95 (64.4)	
22.74 (123.5)	18.41 (100.0)	9.13 (49.6)	15.22 (82.7)	16.26 (88.3)	4.11 (22.3)	9.62 (52.3)	11.97 (65.0)	0.47 (2.6)	4.54 (24.7)	8.44 (45.8)	
23.16 (123.9)	18.69 (100.0)	11.86 (61.5)	16.49 (88.2)	17.29 (92.5)	6.39 (34.2)	11.22 (60.0)	13.46 (72.0)	4.07 (21.8)	6.95 (37.2)	10.04 (53.7)	

It is considered unfortunate that the ban on this substance prevents its employment as a coagulant for jelutong, which is to be used in the manufacture of foodstuffs, since it appears to be very suitable. It is relatively cheap and being a solid is convenient to handle, while only a very small proportion is required as a coagulant.

It must be remembered too that the producer in his own interest must not add an excess of this coagulant, otherwise, instead of being coagulated, the latex will be preserved.

Further, the contention which has been raised by chewing gum manufacturers in the United States of America, that it is uncertain whether all the coagulant will be removed in the subsequent washing and purification processes is considered unreasonable in view of the small amount originally added, the fact that it is added in the form of a solution and the comparatively large volume of serum remaining after coagulation available for solution. As far as is known at present, the phenomenon of coagulation is a physical change, the coagulant not entering into chemical combination with the coagulum.

(c) *Coagulation with Acetic Acid.*—As a result of various experiments it was found that acetic acid in all proportions would effect coagulation of the latex to a certain extent.

Acetic acid of 10 per cent strength was used in the experiments, this particular strength being chosen, so that the distribution of the coagulant when added to the latex might be effected as evenly and rapidly as possible without causing any appreciable dilution of the latex.

A further series of experiments was therefore carried out in order to ascertain the minimum quantity of acid required to effect satisfactory coagulation. It was found that the best results were obtained by the addition of 0.05 gramme of the acid per 100 ccs of latex, equivalent to approximately 0.8 fluid ounces of a 10 per cent solution per gallon of latex.

It may be mentioned here that there is practically no inhibition of coagulation with diluted jelutong latex when acetic acid is used as a coagulant, provided that the amount of acid added is calculated on the volume of the diluted latex. Dilution of the latex however is not desirable, owing to the relatively weak original concentration, the slow rate at which coagulation proceeds, and the fact that dilution involves the treatment of larger quantities of liquid.

With acetic acid, coagulation was complete usually in three days, occasionally in two, though in some cases it was found necessary to prolong the period to four days.

In another series of experiments it was found that the period of coagulation could not be reduced, even when the quantity of acid used was increased to 0.5 gramme per 100 ccs of latex, i.e. 10 times the minimum amount required.

As with sodium silicofluoride, it was found that the average percentage coagulation was between 90 and 95 per cent of that obtained with alcohol. It must be admitted, however, that with certain batches of latex, especially those obtained on days following heavy rainfalls, the percentage coagulation fell considerably, sometimes to approximately 70 per cent, even though the period of coagulation was prolonged to five days. It is difficult to account for this diminution, which can only be explained when a more detailed investigation of the constituents of the latex has been made.

The figures in Table II, extracted from results obtained for the various series of experiments, show the variations in amounts of coagulation on different days. From these results it will be seen that there may be considerable variations in the amount of the coagulum after one day, and it is not until the latex has been standing for at least three days that the amount of the coagulum approaches that obtained by precipitation with alcohol.

It was considered that, in view of the relatively prolonged period of coagulation, it might be advisable to add a small proportion of formalin to the latex, in order to prevent any secondary putrefactive changes which might take place. As a result of experiments it was found that the presence of formalin, even in very small proportions, inhibited coagulation to a considerable extent, and further that the coagulum thus obtained was hard and tough. In an experiment carried out in duplicate it was found that, when the percentage coagulation obtained after three days with acetic acid was 89.6 per cent. the addition of 0.08 parts of formalin per 100 parts of latex reduced the figure to 71.2 per cent.

It is also considered inadvisable to produce a hard and tough coagulum in view of its subsequent treatment, the most satisfactory coagulum from that point of view being one which is soft and spongy.

Preparation of Jelutong by Evaporation of Latex.

It was suggested by one of us that a suitable product might be obtained by the evaporation of latex by the spray process used by the United States Rubber Plantations Incorporated for the preparation of sprayed rubber.

TABLE II.

RESULTS OF COAGULATION EXPERIMENTS WITH ACETIC ACID.

(Results expressed in grammes per 100 c.c. of latex).

Total Solids.	Alcohol Coagulation.	Acetic Acid Coagulation. (0.05 grammes of acid per 100 c.c. latex).				Remarks.
		1 Day.	2 Days.	3 Days.	4 Days.	
19.30	16.16	10.34	14.41	15.94	...	
(119.4)	(100.0)	(64.0)	(89.2)	(98.7)	...	
21.46	17.57	14.61	16.71	17.57	...	
(122.1)	(100.0)	(83.2)	(95.1)	(100.0)	...	The figures in brackets represent the percentages of jelutong obtained in the various experiments, the amount obtained by coagulation with alcohol being taken as 100 per cent.
19.40	15.58	9.90	14.60	15.38	...	
(123.9)	(100.0)	(63.5)	(93.7)	(98.7)	...	
21.36	17.61	8.85	13.15	15.33	...	
(121.3)	(100.0)	(50.2)	(74.7)	(87.0)	...	
18.88	15.79	...	11.48	13.55	14.50	
(119.6)	(100.0)	...	(72.7)	(85.8)	(91.8)	
22.18	18.63	...	16.90	...	...	
(119.1)	(100.0)	...	(90.7)	...	...	
22.08	17.97	...	...	12.78	...	
(122.9)	(100.0)	...	...	(71.1)	...	

A sample prepared in this manner by the representative of one of the American chewing gum manufacturers has been received for examination. This method of preparation cannot be applied commercially at present, owing to the wide areas over which the trees are scattered in the forest, unless some simple, portable and inexpensive machine is designed for treating small quantities of latex.

It is of interest to note however that a patent has been applied for in connection with this method of preparation, which has been found by the applicant to be a valuable one from the point of view of preservation of the product.

Summary.

1. This article deals with the coagulation of jelutong latex.

2. It is shown that sodium silicofluoride is a satisfactory and cheap coagulant, but its use is barred owing to objections raised by manufacturers of chewing gum in the United States of America on account of the food laws, by which certain preservatives, such as sodium silicofluoride are prohibited.

3. It is shown that acetic acid is also a satisfactory coagulant and its use is recommended at the present stage.

4. The problem of the deterioration of jelutong and methods of treatment of the coagulum for preservation during storage are under investigation and will be dealt with in a further paper.

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INOCULATION EXPERIMENTS IN RELATION TO "SUN-SCORCH" ON EXPOSED LATERAL ROOTS OF *HEVEA BRASILIENSIS.*

F. S. Ward.

Numerous experiments have recently been carried out with the view of artificially approximating the conditions bringing about the occurrence of "Sun-Scorch" on the exposed lateral roots of *Hevea brasiliensis.*

The first impression of this outbreak of "Sun-Scorch" was, that the blackened condition of the upper surfaces of the roots was caused by some form of burning. The origin of such scorching effects may be due to several causes such as "leaf fires" or "lightning strike"; in this case, however, these possible causes have upon further investigation been eliminated. It has been shown to be possible, however, by means of artificial leaf fires, to bring about a similar condition of "Sun-Scorch". The cause of this attack of "Sun-Scorch" in 1926, which is the first recorded account in Malaya, has been attributed to the unusually dry weather conditions prevalent during the last wintering season.*

It was necessary in the first experiment to find out whether the Diplodia sp. found in the attacked tissue in roots affected with "Sun-Scorch" was capable of directly infecting healthy root tissue or whether it acted as a wound parasite. Six wounds were made in the following manner on six individual lateral roots. Areas about four inches long and an inch wide were cut into the woody tissue of the roots. The coagulated latex produced at these wounding points was removed on the following day so that the inoculum would have as favourable conditions as possible under which to react. Six pieces of "Sun-Scorch" tissue were then placed on these wounds, the size of these pieces being about the same area as the wounds. These inoculations were then wrapped up in cotton wool, to prevent outside contamination as far as possible and were allowed to remain thus for fourteen days. The results at the end of two weeks were negative. Other similar inoculations were allowed to remain for five weeks and the results were again negative.

The next experiment was to determine the effect of scorching on exposed lateral roots together with subsequent inoculation with tissue from roots affected with so-called "Sun-Scorch". Twelve leaf fires were made on twelve separate roots and the leaves were allowed to burn for approximately five minutes on each root. The leaf fires were made

*Sharples A. "Sun-Scorch" of exposed lateral roots of *Hevea brasiliensis.* Malayan Agricultural Journal Vol. XIV. May 1926 No. 5.

by collecting a couple of handfuls of leaves and placing them on top of each root to be scorched. The following treatment was then carried out:—

(1) Six roots scorched, inoculated with small portions of "Sun-Scorch" tissue.

(2) Six roots scorched, not inoculated (controls).

After two weeks these roots were split open and examined. The roots which had been burnt but not inoculated showed the very early symptoms of "Sun-Scorch", that is, the characteristic discolouration associated with "Sun-Scorch" had only just penetrated into the woody tissue, excepting in two cases where the penetration had gone a little further than in the other cases. Where the roots had been scorched as well as inoculated, the woody tissue in five cases had been well impregnated with the typical discolouration which is found in the more advanced cases of Sun-Scorch." In these inoculations the Diplodia fungus was also found to be present in the woody tissue.

The discolouration of the root tissue, due to "Sun-Scorch", is very typical of the grey discolouration found in the tissue of branches of *Hevea brasiliensis* attacked by the Diplodia sp. causing Die-Back.

Similar scorchings and inoculations with pure cultures of the Diplodia fungus were then carried out. This was done in order to find out whether the Diplodia inoculations had any more pronounced effect than inoculations with tissue from affected "Sun-Scorch" roots. In this series of inoculations it was found that typical symptoms of "Sun-Scorch" were produced in the following experiments where six roots were scorched by means of leaf fires for five minutes in each case:—

(1) Roots scorched and inoculated with a pure culture of Diplodia.

(2) Roots scorched and inoculated with tissue from roots affected with "Sun-Scorch".

(3) Roots scorched, not inoculated (controls).

These inoculations together with the controls were then wrapped in cotton wool and examined three weeks later. The results of No. (1) and (2) of the above showed equally typical symptoms of "Sun-Scorch". In these experiments the results of some of the controls is noteworthy. Instead of all of the roots showing the demarcation immediately below the burnt surface, two roots had this typical discolouration accompanying the presence of Diplodia some distance away from the scorched area. It seems probable that these instances may be due to fissures

produced in the cortex, as the result of the expansion of the tissue, after scorching, which proved more suitable for the entrance of the Diplodia fungus than openings which might be present in the more severely scorched bark.

Scorches of much less severity were then carried out in order to ascertain the approximate amount of scorching required to cause the Diplodia fungus readily to gain an entrance into the tissue of the root. This was done by heating an iron bar until it was red hot and placing it on the roots. Each root was scorched in this manner for five seconds, the scorched area on the root being about half an inch square in each case. Eighteen scorches of this type were made as follows:—

(1) Six were left as controls and not wrapped up in cotton wool.

(2) Six were wrapped up in cotton wool and kept moist.

(3) Six were inoculated with small portions of Diplodia and wrapped up in cotton wool.

These were all left for three weeks, after which time the results were found to be practicably negligible. Two inoculations in (2) of the above showed a slight discolouration in the woody tissue but no Diplodia was found to be present. This experiment indicated that the scorching was insufficient so that a similar type of experiment was carried out excepting that each root was scorched for thirty seconds. Twelve scorches of this kind were made and treated in the following manner:—

(1) Six were inoculated with Diplodia and wrapped up in cotton wool.

(2) Six were left as controls and not wrapped up in cotton wool.

In the case of the controls there was only one instance where the Diplodia had penetrated into the wood. In number (1) of the above there were three cases where the Diplodia had started to penetrate into the wood. It seems probable that if in these latter inoculations the roots had been scorched for about a minute and allowed to remain for the same number of days as in the previous experiment, all of the results would have been positive.

A few preliminary experiments were carried out on the branches of *Hevea brasiliensis* in order to find out whether similar effects to those produced in the roots could be produced in the branches. Four scorches were made with a

heated iron bar, each scorch lasting for thirty seconds. Inoculations were then made with pure cultures of the Diplodia fungus. After leaving these inoculations for three weeks similar symptoms were found to those in the roots which had been treated in the same way. The progress of the fungus here, as in the roots, was found to be along through the woody tissue and not in the cortex. Branches of *Hevea brasiliensis* were also inoculated with Diplodia without these branches being previously scorched. Although these inoculations have been going on for over six weeks, the fungus has not as yet penetrated into the wood.

These inoculation experiments indicate that the Diplodia sp. usually found associated with affections of *Hevea brasiliensis* i. e. "Lightning strike," "Die-Back," "Sun-Scorch" of exposed lateral roots, is not an ordinary wound parasite as is commonly assumed, but is rather a special type of wound parasite which under certain conditions allowing for sufficient heating of localised areas of cortical tissue, results in a strong infection and in the fungus making rapid headway in the woody tissue of *Hevea brasiliensis*. In these experiments there is also suggested the possibility of explaining the common occurrence of "Die-Back" in Malayan plantations after wintering.

The so-called "Die-Back" on hilly lands which have suffered badly from soil wash or on rubber growing areas which have been neglected in other ways, is of considerable importance in Malaya. The experiments which have been just recently undertaken in connection with "Sun-Scorch" suggested an enquiry as to whether the Diplodia sp. was the prominent fungus present in this particular kind of affection. One hundred and five branches of *Hevea brasiliensis* suffering from "Die-Back" were split open, the results are given below:—

(1)	Typical Diplodia ...	11 cases
(2)	Diplodia present with other fungi or insects ...	22 ,,
(3)	No Diplodia present ...	72 ,,

In these branches killed by "Die-Back" numerous fungi occur. One of the most common fungi present is *Polyporus hirsutus* Fr., another is *Hexagonia tenuis* Hook. this species differs from the type species of *Hexagonia tenuis* Hook. and may be a new species. Another common fungus is a white Poria sp. which has not yet been determined. A further detailed report upon these fungi will be issued later.

Thanks are due to Mr. Holttum, Acting Director, Botanic Gardens, Singapore, for identifications.

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OIL FROM ALEURITES TRISPERMA.

C. D. V. Georgi.

A large sample of these nuts was received recently from Mr. A. M. Tuke, Kota Tampan Estate, Lenggong.

The oil content of nuts of this species of *Aleurites* from locally cultivated trees has not been determined previously. It was considered advisable therefore to investigate both the oil content of the nuts and the physical and chemical constants of the oil in order to obtain data to compare this oil with candlenut oil obtained from another species *Aleurites triloba* (syn. *Aleurites moluccana*.) Candlenut oil is well known in this country.

A botanical description of *Aleurites trisperma* has already been published in this Journal, compare "Candlenut and Chinese Wood Oil Trees" by W. N. Sands, Vol. XII, January 1924, No. 1, page 1.

Oil Content of Nut.

The following results were obtained on analysis, the figures for the analysis of a sample of candlenuts being added for purposes of comparison:—

	A. triloba.	*A. trisperma.*
Average weight of nut	7.4 grammes	5.5 grammes
	per cent.	per cent.
Shell	67.5	43.6
Kernel	32.5	56.4
Kernel		
Moisture (loss at 100°C)	5.1	4.2
Oil (Chloroform extract)	62.3	50.9
Residue (by difference)	32.6	44.9
Oil (calculated on dry kernel)	65.6	53.1
Nut		
Oil (calculated on whole nut)	20.2	28.7

These results show that, although the oil content of the kernel of *A. trisperma* is less than that of the candlenut, the percentage of oil calculated on the whole nut is considerably greater, on account of the larger proportion of kernel.

Analytical Constants of Oil.

The kernels were shredded and pressed in a small hand-press, the residue bing warmed and pressed a second

time in order to recover as much as possible of the oil for the determination of the physical and chemical constants.

The expressed oil was clear, yellow in colour and had a sweetish odour unlike the oil from candlenuts.

The results of analysis are shown in the following table, figures for a sample of similar oil from nuts grown in the Philippines (compare R. H. Aguilar, Philippine Journal of Science, 1917, page 235) and for candlenut oil being added for purposes of comparison:—

Constant	Present sample	Oil from Philippines	Candlenut oil
Specific Gravity at 15.5°C	0.935	0.9368	0.929
Iodine value (Wijs)	111.4	145.25	149.0
Saponification value	195.8	197.7	193.3
Acidity (Oleic acid, per cent)	1.1	4.4	2.3

These results show that the oil obtained from *A. trisperma* does not possess such good drying properties as candlenut oil, for which it could not be used as a substitute.

This oil can only be classed therefore as a semi-drying oil on account of its medium Iodine value. This is proved by experiments, the oil from *A. trisperma* shows no tendency to jellify when heated, and the film produced on drying is hard and powdery. It is interesting to note the variation in the Iodine values of oil obtained from trees in the Philippines and in this country. The variation is too great to be ascribed to any difference of experimental methods and can only be due to some variability in the character of the oil.

Similar variations have also been noticed in the case of candlenut oil prepared from trees cultivated in the Cameroons, West Africa, as compared with that from other countries. (Compare "Chemical Technology and Analysis of Oils, Fats and Waxes," Lewkowitsch and Warburton, Vol. II page 89).

Received for publication 13th July, 1926.

OIL FROM ALEURITES SPECIES.

C. D. V. Georgi.

A further series of experiments on the treatment of candlenuts and the expression of the oil has been carried out recently, in view of the comparative failure on a large scale of the proposed method of separating shells and kernels by heating the nuts and then plunging into cold water, as described in an article under the above heading in this Journal, Vol. X., No. 8, August 1922, page 203.

Experiments with a nut cracker on samples of the nuts sent to the Imperial Institute also showed that many kernels were broken and many of the broken pieces of the kernels adhered to the shell.

A supply of nuts for these experiments was again placed at the disposal of the Department by Mr. A. M. Tuke, Kota Tampan Estate, Lenggong, Upper Perak.

Analysis of Nuts.

The results of analysis of a sample of nuts were as follows, the figures obtained for a previous sample of these nuts being added for purposes of comparison. It will be seen that the figures show only slight variations:—

	Present Sample.	Previous Sample.
Average weight of nut	8.1 grammes.	7.4 grammes.
	per cent.	per cent.
Shell	66.4	67.5
Kernel	33.6	32.5
Kernel		
Moisture	5.3	5.1
Oil (Chloroform extract)	61.2	62.3
Residue (by difference)	33.5	32.6
Nut		
Oil (calculated on whole nut)	20.6	20.2

Expression of Oil.

It was thought that a satisfactory method of dealing with the nuts would be to crush them whole in an edge-runner mill and then to press the mass. This method would render unnecessary the separation of shells and kernels, though it was doubtful whether it would be possible to reduce the shells to a sufficiently fine state of division for pressing, and also whether the expression of oil would be satisfactory on account of the introduction into the press of such a large proportion of oil-free material.

Experiment 1.—A trial experiment showed that under these conditions the expression of oil was unsatisfactory. The yield of oil was poor, and the colour dark, on account of the prolonged period of crushing in the mill necessary to reduce the shells to the required fineness.

During this experiment it was noticed that the bulk of the kernels was reduced to a coarse meal after a few minutes grinding, while the shells were only slightly affected. It was thought possible therefore that a separation of shells and kernels might be effected in this way, that is to say, by grinding the nuts in the mill for a few minutes and then sieving the mass through a coarse sieve, returning the material remaining on the sieve to the mill for further treatment if necessary.

Experiment 2.—A batch of 8 lbs. of the nuts was cracked with a hammer and treated for about three minutes in the edge-runner mill, the crushed mass being then sieved on a 3 mms. sieve. The sievings consisted almost entirely of kernel, the residue on the sieve also contained fragments of kernel. This residue was therefore returned to the mill and the process of grinding continued for a further 15 minutes, when the mass was sieved again. The second sievings contained a small proportion of fragments of shell mixed with the kernel, while the residue on the sieve consisted almost entirely of slightly oily fragments of shell. It was obvious that no useful purpose would be served by continuing the grinding of this residue in the mill.

The first and second sievings were mixed and cold-pressed in a small hand press, the residue broken up, heated and hot-pressed.

The results of two experiments were as follows:—

	Expt. A. lbs.	Expt. B. lbs.
Weight of nuts taken ...	8.00	8.00
Sievings.		
Weight of first sievings ...	1.75	2.00
Weight of second sievings ...	0.94	0.75
Total ...	2.69	2.75
Yield of cold-pressed oil ...	1.00	1.04
Yield of hot-pressed oil ...	0.32	0.32
Total ...	1.32	1.36
Yield of oil on nuts, per cent ...	16.5	17.0

From these two experiments it will be seen that between 82 and 85 per cent of the oil has been expressed, assuming a 20 per cent oil content of the nut.

The results of four further experiments as regards weights of sievings gave 2.63 lbs., 2.88 lbs., 2.63 lbs. and 2.69 lbs. respectively, an average of 2.71 lbs. of sievings for 8 lbs. of nuts.

Analysis of Oil.

A sample of the oil prepared in this way was tested for Iodine value and acidity, and the results showed that these constants compared favourably with those obtained with a previous sample of oil prepared by another method.

Constants	Present Sample	Previous Sample
Iodine value (Wijs) ...	152.8	149.0
Acidity (Oleic acid, per cent)	2.4	2.5

Remarks and Conclusions.

The results of the experiments show that it is possible to separate the shells and kernels of candlenuts satisfactorily by crushing the nuts for a few minutes in an edge runner mill, and then passing the material through a coarse sieve, repeating the process until no more fragments of kernel separate on sieving.

The combined sievings are then pressed and, using only a small hand-press, it is possible to recover 85 per cent of the oil content of the nuts.

The Iodine value and acidity of the oil are satisfactory and the colour of the oil does not appear to have been affected by the treatment.

It is thought that this method of expressing oil is worth consideration where large quantities of the nuts are available.

It must be remembered that it would not be practicable to carry out the method by using fresh nuts, since the moisture content of fresh kernels from such nuts is about 25 per cent, and the action of grinding such moist kernels would result in the conversion of the material into a pasty mass. The nuts should therefore be sun-dried until the weight remains constant.

Further, when working on a large scale, it is thought that the mesh of the sieve might be increased without a corresponding loss of efficiency. If the material were sieved through $\frac{1}{6}$ inch or $\frac{1}{8}$ inch mesh sieve, it is considered that the small amount of extra fragments of shell would not affect

the efficiency of the subsequent expression of oil, which should reach at least 90 per cent of the oil content of the nuts

This method of crushing and pressing kernels containing a certain proportion of shell is also satisfactory on account of the fact that the residual cake or meal, even when free from shell, cannot be used as a cattle food, owing to its toxic character. The proportion of shell will not materially affect the value of the material as a fertilizer.

Received for publication 10th July, 1926.

A PRELIMINARY REPORT ON MOLASSES GRASS.

J. N. Milsum.

Molasses grass, *Melinis minutiflora, Beauv.*, known under the name of 'Efwatakala' by the natives of West Africa, was reported as of probable economic value in tropical regions by Mr. M. T. Dawe, when making an agricultural survey of Angola in 1921 (*Tropical Life*, 1922, 18, 69). The grass was considered valuable in two respects: firstly on account of its strong odour and sticky hairs causing it to be distasteful to the tsetse fly, and secondly as a fodder crop for cattle.

The structure of the glandular hairs and the viscid oil secreted therefrom has been described fully in *Kew Bulletin*, 1922, XLVI, p.305. From this it appears that two types of hairs are produced: one with a rounded apex, the other being sharp-pointed. Oil is secreted in both types of hairs, but is only excreted from the blunt hairs. The hairs are most numerous on the leaf sheaths, but also occur on both sides of the blade. The fresh plant is stated to yield about 0.001 per cent. of volatile oil having the characteristic odour of the fresh grass.

It is stated, in the *Kew Bulletin* referred to above, that the natives of Portugese Congo use the grass for making nests for sitting fowls and as a bedding for dogs with pups, as it prevents the fowls and dogs being attacked by fleas. In South America, it is known to be objectionable to ticks and cattle fed on this grass are said to be less worried by these insects, without detriment to meat and milk of such cattle.

Reports from various sources as to the value of the grass as a fodder are contained in the *Bulletin of the Imperial Institute*, Vol. XX, 1922, p. 300. In trials in Southern Rhodesia, yields of 5 tons of dried hay per acre were obtained in 1916-17 and 3½ tons in 1917-18. It is stated that in the fresh state, some animals will not eat it owing to its smell, but this is overcome when the grass is fed dry. Dried samples of the grass were examined at the Imperial Institute, London, from material collected in the Portugese Congo. No volatile oil or sticky exudations were present owing to drying. The results show that this grass is of fair quality as a fodder, although it contains less proteins and more fibre than three other grasses—elephant grass (8 weeks old) millet hay and timothy grass hay.

In Java this grass has been grown for some considerable time. It is not classed as high as Guinea grass (*Panicum maximum*), in respect of yield (*Teysmannia;* 1907, p. 273). The grass is, however, stated to yield extraordinary well at

altitudes between 600 and 1600 meters. In certain mountainous districts of West Java, the grass is growing wild over large areas and is much used by natives as a fodder for horses.

In a letter received by the Department of Agriculture, F.M.S. and S.S. from the Chief Agriculturist, Salisbury, Rhodesia, the grass is stated to yield an average of 3 to 4 tons of hay per acre, from the one cutting that is obtainable. The grass is said to be inclined to die out in patches and no cases of re-seeding were noticed. Further, the cured hay was considered coarse, but is eaten by stock when once used to it.

Seeds of this grass were received at the Experimental Plantation, Serdang, from the Agricultural Department of Rhodesia in June, 1923. The seed was sown in an open bed and germinated rapidly. The seedlings grew strongly and soon covered the bed forming a dense mass of herbage. When the grass was about six months old it commenced to flower. At a later date, attempts were made to feed the fodder to cattle on the plantation with little success, the grass evidently being too old. Rooted cuttings were taken from the horizontal stems and planted out at a distance of 2 ft. x 2 ft. on a square chain of land in the middle of October, 1925. The cuttings took root readily and early in the following May signs of flowering became evident, when a commencement was made to cut the fodder. The grass was fed fresh to working Siamese bullocks at the rate of 50—60 lbs. each per day. The cattle eat the grass greedily and showed every appearance of relishing it. Guinea grass and Napier grass had been fed previously and the animals appeared to appreciate Molasses grass equally as well. The actual amount of green fodder cut from the square chain was 2075 lbs., or a calculated yield of about 9.25 tons per acre. Only the young herbage was removed, allowing the horizontal basal growths to remain on the land. The area under this grass appears to be making satisfactory growth, but no information is available as to when the second crop will be ready to cut and what yield will be forthcoming. It appears doubtful however, whether this grass will yield as heavily as Guinea grass, which at Serdang gives a return of 40 tons of green fodder per acre per annum.

Cuttings of this grass were distributed to an estate on the coast of Selangor for use in preventing the encroachment of lalang on the boundaries. The Manager reported that he considered it a suitable grass for this purpose although insufficiently strong as an eradicator of lalang.

To summarise, it may be stated that Molasses grass grows luxuriantly in this country, producing a dense mass of foliage within about six months of planting from cuttings. It has not so far been raised from seed other than in the

original case mentioned above, as this method is slower and requires more attention as regards keeping the land clean during the early stages of growth. Chance seedlings have been noticed growing near-by the mature plants. The grass appears a good fodder so far as observations have been made to date, but it has not been possible to make comparative tests with other fodder grasses. As to whether its employment as a fodder for cattle would result in their being less affected by ticks is worth investigation and will be carefully watched.

Received for publication, 10th September, 1926.

THE EFFECT OF EFFLUENTS FROM RUBBER FACTORIES ON PADI AND THEIR TREATMENT.

B. J. Eaton.

According to the Economic Botanist, the effluent from rubber factories has an undoubted deleterious effect on the growth of padi. No information however is available as to the necessary dilution of such effluents to render them innocuous when flowing into water used for irrigating padi fields.

It is practically certain that the harmful effect must be due to the acidity (caused normally by the acetic acid used as a coagulant) since such effluent, apart from the coagulant (and traces of sodium bisulphite which has previously been oxidised) contains only a small proportion of salts (including phosphates) and organic nitrogenous matter, which would be useful as plant nutrients.

Treatment of effluents.—The simplest and most economical method of rendering such effluents innocuous would be to allow the effluent to flow into a sump containing lumps of limestone, preferably graded, as in the case of gravel and sand in filter beds, i.e. large lumps at the bottom, becoming smaller near the top, say three or four grades of sizes. Such a sump can be made simply by digging a hole in the ground at or near the end of the drainage system of the factory and filling this almost completely with the limestone. The limestone will neutralise the acetic acid and also aerate the effluent. As the acid effluent will slowly dissolve the limestone, it will be necessary to replace it periodically.

The size of the sump will depend on the amount and rate of flow of the effluent. Its efficiency can be tested by determining the acidity and character of the effluent after passing through the limestone. It would also add to the efficiency of the sump to place lumps of limestone in the drains into which the effluent flows, before and after it reaches the sump. It is possible that if the drains are sufficiently long, a sump may not be necessary, since it may be possible to place sufficient limestone in the drains to neutralise the acid in the effluent. This can be ascertained by testing the acidity of the effluent after such treatment.

In the case of any factory, in which such treatment has been found necessary, owing to complaints received on account of the effect of the effluent on padi irrigation water the Agricultural Chemist will be pleased to examine and report on such effluents.

Received for publication 7th July, 1926.

ASEPTOSOL.

A New Antiseptic Phenol.

J. Mc Lang (Berlin) has investigated a new phenol present in the leaves of *Chavica Betle*, the leaves of which are chewed with areca nut, catechu (gambier) and lime (slaked lime or calcium hydroxide) by many Asiatics in the East.

Apart from the pleasant aroma and taste of this mixture when chewed, it is known to have a preservative and whitening effect on the teeth. It is probable that the lime acts on salts of the various aromatic bodies present, and causes a separation of these, which modify the aroma and taste.

The essential or volatile oil from the leaves of *Chavica Betle* has been found to contain a very active antiseptic phenol which has been named " Aseptosol ".

This phenol is distinct from " Chavicol ", previously isolated from the leaves, which is a mixture of substances containing "Aseptosol." It has previously been shown (Ber. 22, 2726, 1889) that "Chavicol" is about five times as powerful as phenol (carbolic acid) as a bactericide, in the case of at least five well known bacterial organisms.

" Aseptosol " has now been found to be much more active and stable than "Chavicol" and has been isolated as a pure product (M. P. 15.8°C; B. P. 230°—231°C; Sp. Gr. at 15°C=1.0203). The compound is white and has an odour somewhat resembling that of phenol. It is interesting to note that scientific investigation has confirmed the value of chewing this mixture, a practice which is so widespread among Asiatics.

(Note: Abstracted from " The Chemical Trade Journal and Chemical Engineer", Volume LXXVIII, No. 2033. May 7, 1926, p. 560).

B. J. E.

Received for publication 7th July, 1926.

LONDON MARKET PRICE LIST, 2nd QUARTER 1926.

Oil Seeds.

Castor (Bombay)	-	£17.12.6 to	£17. 2.6	per ton.
Copra (Ceylon)	-	£30. 7.6 to	£29.18.9	,,
Copra (Straits)	-	£29. 5.0 to	£29.10.0	,,
Cotton Seed	-	£ 9. 7.6 to	£10.12.6	,,
Dessiccated Coconut (fine)	-	£ 1.19.0		per cwt.
,, ,, (medium)	-	£ 1.19.0		,,
,, ,, (coarse)	-	£ 2. 3.0		,,
Linseed (Bombay)	-	£16.15.0 to	£18	per ton.
,, (Plate)	-	£14.11.0 to	£15.12.6	,,
Palm Kernels (West African)	-	£20.10.0 to	£21.5 .0	,,

Oils.

Castor (First pressing)	-	£46 to	£45.10.0	,,
Coconut (Cochin)	-	£57 to	£55	,,
Coconut (Ceylon)	-	£47 to	£47.10.0	,,
Cotton Seed (Egyptian Crude)	-	£36 to	£41	,,
Linseed	-	£31 to	£33.10.0	,,
Palm (Lagos)	-	£38.10.0 to	£41	,,
Palm Kernel	-	£42 to	£44.10.0	,,

Oil Cakes.

Coconut	-	£ 9 to	£ 8. 5.0	,,
Cotton (Egyptian seed)	-	£ 9.15.0 to	£ 6.10.0	,,
,, (Bombay seed)	-	£ 5. 5.0 to	£ 5.12.6	,,
Ground nut (London decorticated)		£12		,,
Linseed 9%	-	£10.15.0 to	£11	,,
Palm Kernel	-	£ 6.5 .0 to	£6 .10.0	,,

Essential Oils.

Cajeput	-	2/11 to	2/6	per lb.
Camphor (Chinese, Crude)	-	2/6 to	2/7	,,
,, (Japanese, refined)	-	2/11 to	3/9	,,
Camphor oil (white, distilled)	-	£3 to	£3 .2 .6	per cwt.
Cinnamon (Ceylon leaf)	-	5/6		per lb.
Citronella (Ceylon)	-	2/2 to	1/9½	,,
Citronella (Java)	-	3/2 to	2/6	,,
Clove	-	6/3 to	6/6	,,
Lemon Grass (Cochin)	-	3/8½ to	3.10½	,,
Lime (West Indian distilled)	-	£1.5.0 to	£1 .10.0	,,
Patchouli (Penang)	-	£1.1.6 to	£1 . 2.0	,,
,, (Mysore)	-	£1.7.0		,,
Vetiver (Bourbon)	-	£2.5.0		,,
,, (Java)	-	£3		,,

Spices.

Capsicums (East Indian)	£2	to	£2. 5.0	per cwt.
„ (Nyassaland)	£3	to	£3.10.0	„
Chillies (Zanzibar)	£1.15.0	to	£2. 2.6	„
„ (Nyassaland)	£2.10.0	to	£3. 5.0	„
„ (Japan)	£5	to	£4.15.0	„
Cinnamon (Ceylon)	1/9	to	2/0	per lb.
Cloves (Zanzibar)	9½d	to	11d.	„
„ (Penang)	2/	to	2/2	„
Ginger (Japan)	55/			per cwt.
„ (Jamaica)	80/	to	120	„
Mace (Bombay & Penang)	3/7	to	4/-	per lb.
Nutmegs (Singapore & Penang)				
110's	1/9	to	1/10	„
80's	1/11	to	2/2	„
64—57's	2/4	to	2/6	„
Pepper (Singapore black)	11d.			„
Pepper (Singapore white)	1/1½	to	1/4	„

Drugs.

Ipecacuanha (Rio)	14/-	to	14/6	per lb.

Natural Dyes & Extracts.

Annatto	4d.	to	5d.	per lb.
Gambier (block)	55/-	to	44/-	per cwt.
do (cube)	75/-	to	65/-	„

Gums and Resins.

Damar (Singapore)	30/-	to	150/-	„
do (Batavia)	125/-	to	155/-	„
Dragon's Blood (reeds)	£15	to	£20	„
Gutta Percha (genuine)	2/9	to	6/-	per lb.
do (Sarawak)	3/-	to	4/-	„
do (Siak, reboiled)	1/5			„
Jelutong	1/6	to	10d.	„

Fibres.

Cotton (American Go. to Mid.)	7.04d	to	10.09d	„
do (Egyptian Sakellarides G. F. to Fine)	14.45d	to	17.60d	„
Hemp (Manila "J" Grade)	£38.10.0	to	£42 per ton.	
do (Mauritius)	£39	to	£41	„
do (New Zealand)	£34	to	£38	„
do (Sisal)	£22	to	£48.10.0	„
Kapok (Indian)	-/8d	to	1/1¾	per lb.
do (Java)	1/4½	to	1/4¾	„

Foodstuffs.

Arrowroot (Natal)	-	-/8d to -/9d	per lb.
Cocoa (Ceylon Plantation)	-	72/- to 92/-	per cwt.
Coffee (Malay Plantation)	-	110/- to 130/-	,,
do (Liberian)	-	100/- to 105/-	,,
Sago (Pearl)	-	28/-	,,
do (Flour)	-	17/6 to 18/6	,,
Sugar (Java, white)	-	£1.6.3	,,
Tapioca (Penang, flake)	-	-/2¼d to -/3d	per lb.
Tapioca (Penang, flour)	-	18/- to 22/-	per cwt.
do (do. pearl)	-	28/-	,,

Chemicals.

Acetic Acid (glacial)	-	£66	per ton.
do. (86% con.)	-	£37.15	per cwt.
Acetone	-	£80 to £81	per ton.
Ammonia (.880)	-	£21	,,
Calcium Acetate (grey)	-	£16	,,
Citric Acid	-	1/4 to 1/4½	per lb.
Formic Acid (85%)	-	£48.10.0	per ton.
Formalin (40% Vol)	-	£40	,,
Lime Juice (conc) nom.	-	£20	,,
Sodium bisulphite (60—62%)	-	£17	,,
Sodium Sulphite (Anhydrous)	-	£27.10.0 to £28.10.0	,,
Wood Creosote (unrefined)	-	2/9	per gal.

The market for most commodities was affected by the General Strike. The difficulty was frequently that of transport facilities rather than lack of orders. The prices given in the above list are therefore in many cases, of a nominal nature.

Prices in most of the commodities which interest Malaya were well maintained. The oil market felt some fluctuations, but ends firm. The chemical market remains at about the same prices as ruled during the first quarter.

Errata.—Market Price List, first quarter, Malayan Agricultural Journal page 129. The prices quoted for hemps should read "per ton." Page 130 Sodium Sulphite (anhydrous) should be £27 instead of £14 as stated. Page 131, 12th line down "1925," should read "1926."

Note.—The above market price list is merely intended to indicate the trend of prices over the period under review. The list is based on various issues of the following journals published during the second quarter of 1926 :—

Lewis and Peat Monthly Prices Current : Lewis and Peat, West Indian, Central American and Brazilian Monthly Market Report ; Tropical Life ; British Trade Journal ; Fertilisers and Feeding Stuffs Journal ; Chemist and Druggist ; Chemical Trade Journal ; Chemical Age ; Perfumery and Essential Oil Record.

Received for publication 22nd September 1926.

Publications of the Department of Agriculture.

The following publications, except those out of print, may be obtained on application to the Office of the Secretary for Agriculture; and the Malay States Information Agency, 88, Cannon Street, E.C. London.

A remittance to cover the cost should accompany applications; otherwise the Journals will be sent by post, Cash on Delivery, where that system is in force.

1. The Agricultural Bulletin F.M.S.

Vols. I—IV (1913-16) VIII & IX (1920-21)		price	$5.00 per volume.
Vol. V	(1917) Nos. 1, 2, 3, 5 & 6	„	2.50 per set.
„ VII	(1919) „ 2—6	„	4.50 „

(Vol. VI is out of print.)

2. The Malayan Agricultural Journal (continuing the Agricultural Bulletin) Published monthly.

Vol. X (1922)	Price $5.00 per volume.
„ XI (1923)	Price $5.00 per volume or 50 cents per single number.
„ XII (1924)	„ „ „ „

Back numbers of Vols. I—X will not be sold singly.

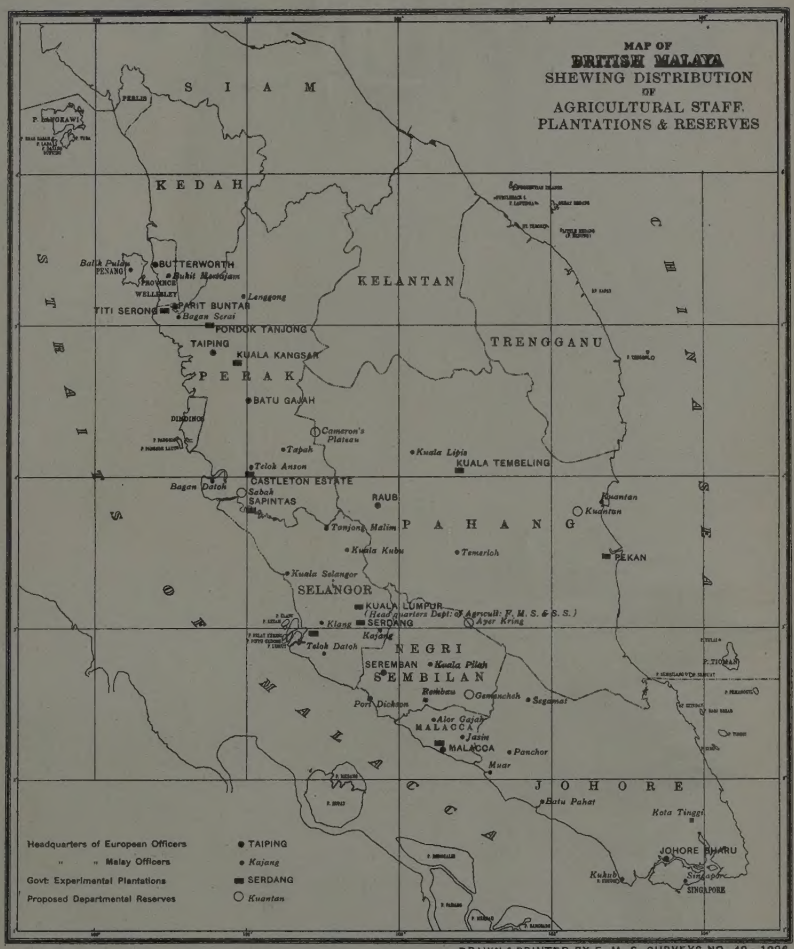
3. The Handbook of Malayan Agriculture, price $1.00.

Current numbers of the Malayan Agricultural Journal and the Handbook may be purchased from the Railway Bookstalls and Branches of Messrs. The Federal Rubber Stamp Co.

4. *Special Bulletins.*

1. Notes on *Termes Gestroi* and other species of Termites found on Rubber Estates in the Federated Malay States, by H. C. Pratt, 1909, 20 cts.
2. Root Diseases of *Hevea Brasiliensis*, by W. J. Gallagher. C
3. Observations on *Termes Gestroi* as affecting the Para Rubber Tree and methods to be employed against its Ravages, by H. C. Pratt, 1910, 20 cts.
4. *Brachartona catoxantha, Hamps*, by H. C. Pratt, 1909. C
5. The Extermination of Rats in Rice Fields, by W. J. Gallagher, 1909. C
6. Branch and Stem Disease of *Hevea Brasilienisis*, by W. J. Gallagher, 1909. C
7. Coffea Robusta, by W. J. Gallagher, Government Mycologist, 1910, 20 cts.
8. The Cultivation and Care of the Para Rubber Tree (in Malay) 1910. C
9. Die-Back Fungus of Para Rubber and of Cacao, by K. Bancroft, 1911. C
10. A Lecture on the Para Rubber Tree, by W. J. Gallagher, 1910. C
11. Coconut Cultivation, by L. C. Brown, 1911 C
12. Padi Cultivation in Krian, by H. C. Pratt, 1911 C
13. A Root Disease of Para Rubber, *Fomes Semitostus*, by K. Bancroft, 1912, 20 cts.

C = Cancelled



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